

## CLAIMS

What is claimed is:

1. A method for implementing protection switching for a virtual private network  
5 comprising the steps of:

establishing a working virtual private network path and a protection virtual private network path between a first edge node and a second edge node;

- 10 detecting traffic congestion in the working virtual private network path; and

switching traffic from the working virtual private network path to the protection virtual private network path when detected traffic congestion in the working virtual private network path exceeds a predetermined threshold.

- 15 2. The method of claim 1 further comprising:

detecting failure of the working virtual private network path; and

- 20 switching traffic from the working virtual private network path to the protection virtual private network path when failure of the working virtual private network path is detected.

3. The method of claim 1 further comprising:

detecting a return to proper functioning of the working virtual private network path; and

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switching traffic from the protection virtual private network path to the working virtual private network path when said return to proper functioning of the working virtual private network path is detected.

10 4. The method of claim 1 further comprising:

establishing a management channel in at least one of said working virtual private network paths;

15 connecting said management channel between said first edge node and said second edge node;

transmitting time stamps across said management channel;

20 transmitting network measurement parameters across said management channel;

and

analyzing said time stamps and said network management parameters to detect failures or congestion in said working virtual private network path.

5. The method of claim 4, wherein said time stamps and said network management parameters are analyzed by an algorithm in said first node.

6. The method of claim 4, wherein said time stamps and said network management  
5 parameters are analyzed by an algorithm in said second node.

7. The method of claim 4, wherein said management channel uses less than ten percent of overall capacity of said working virtual private network path.

10 8. The method of claim 1 further comprising:

sending time stamps across said working virtual private network path and said  
protection virtual private network path;

15 9. The method of claim 8 further comprising:

utilizing said time stamps for synchronizing data transmission across said working  
virtual private network path and said protection virtual private network path; and

20 10. The method of claim 8 further comprising:

utilizing said time stamps to enable recovery of data lost on said working virtual  
private network path and said protection virtual private network path.

11. The method of claim 1 further comprising:

establishing quality of service parameters for said working virtual private network  
5 path and said protection virtual private network path;

assigning the quality of service parameters to said working virtual private network  
path and said protection virtual private network path; and

10 synchronizing said first edge node and said second edge node according to the  
quality of service parameters.

12. An apparatus for protection switching of a virtual private network comprising:

15 a working virtual private network path connected between a first edge node and a  
second edge node;

a protection virtual private network path connected between the first edge node  
and the second edge node;

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a congestion detector; and

a data switch,

wherein when data is transmitted across the working virtual private network path, said congestion detector detects traffic congestion on said working virtual private network path and said data switch switches said data from said working virtual private network path to said protection virtual private network path when said traffic congestion  
5 exceeds a predetermined threshold, thereby ensuring continuous transmission of said data across said virtual private network.

13. The apparatus of claim 12 further comprising a failure detector, wherein said failure detector detects failure of said working virtual private network path and said data  
10 switch switches said data from said working virtual private network path to said protection virtual private network path when said failure is detected by said failure detector.

14. The apparatus of claim 11 further comprising:  
15 a normal operation detector; and

a second data switch,

20 wherein when said normal operation detector detects a return to normal functioning of said working virtual private network path, said second data switch switches said data from said protection virtual private network path to said working virtual private network path.

15. The apparatus of claim 11 further comprising:

5 a management channel in at least one of said working virtual private network paths;

a plurality of time stamps transmitted across said management channel; and

10 a plurality of network measurement parameters transmitted across said management channel;

wherein said time stamps and said network management parameters are analyzed to detect failures or congestion in said working virtual private network path.

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16. The apparatus of claim 15, wherein said time stamps and said network management parameters are analyzed by an algorithm in said first edge node.

17. The apparatus of claim 15, wherein said time stamps and said network  
20 management parameters are analyzed by an algorithm in said second edge node.

18. The apparatus of claim 15 wherein said management channel utilizes less than ten percent of overall capacity of said working virtual private network path.

19. The apparatus of claim 11 further comprising a plurality of time stamps sent across said working virtual private network path and said protection virtual private network path.

5 20. The apparatus of claim 19, wherein said plurality of time stamps synchronize data transmitted across said working virtual private network path and said protection virtual private network path.

21. The apparatus of claim 19, wherein said plurality of time stamps enable recovery  
10 of data lost from said working virtual private network path and said protection virtual private network path.

22. The method of claim 11 further comprising a plurality of quality of service  
parameters assigned to said working virtual private network path and said protection  
15 virtual private network path.

23. The method of claim 22, wherein said first edge node and said second edge node are synchronized according to said plurality of quality of service parameters.